Geophysical Research Abstracts
Vol. 16, EGU2014-5649, 2014
EGU General Assembly 2014

Investigation of nucleation, dynamic growth and surface properties of single ice crystals

Jens Voigtlaender (1), Paul Herenz (1), Cédric Chou (2), Henner Bieligk (1), Tina Clauss (1), Dennis Niedermeier (1), Georg Ritter (2), Joseph Z. Ulanowski (2), and Frank Stratmann (1)

(1) Leibniz Institute for Tropospheric Research, Leipzig, Germany (jensv@tropos.de), (2) Science & Technology Research Institute, University of Hertfordshire, UK

Nucleation, dynamic growth and optical light scattering properties of a fixed single ice crystal have been experimentally characterized in dependence of both, the type of the ice nucleus (IN) and the prevailing thermodynamic conditions. The set up was developed based on the laminar flow tube LACIS (Leipzig Aerosol Cloud Interaction Simulator, Stratmann et al., 2004; Hartmann et al., 2011). The flow tube is equipped with a SID3-type (Small Ice Detector, Kaye et al., 2008) instrument called LISA (LACIS Ice Scattering Apparatus) and an additional optical microscope. For the investigations, a single (IN with a dry size of 2-10 micrometer is attached to a thin glass fiber and positioned within the optical measuring volume of LISA. The fixed particle is exposed to the thermodynamically controlled air flow, exiting the flow tube. Temperature and saturation ratio in the measuring volume can be varied on a time scale of 1-2 s by adjusting the humidified gas flow. Dependent on the thermodynamic conditions, ice nucleation and ice particle growth/shrinkage occur and can be studied. Thereby, the LISA instrument is applied to obtain 2-D light scattering patterns, and the additional optical microscope allows a time dependent visualization of the ice crystal. Both devices together allow to investigate the influence of the thermodynamic conditions on ice particle growth, the particle shape and its surface properties (i.e. its surface roughness, Ulanowski et al., 2011; Ulanowski et al., 2012; Ulanowski et al., 2013)).

The thermodynamic conditions in the optical measuring volume have been extensively characterized using a) computational fluid dynamics (CFD) calculations, b) temperature and dew-point measurements, and c) evaluation of droplet and ice particle growth data. Furthermore, we successfully performed condensation freezing and deposition nucleation experiments with ATD (Arizona Test Dust), kaolinite, illite and SnomaxTM (Johnson Controls Snow, Colorado, USA) particles. In the experiments we could prove that different types of IN, as well as different temperatures and saturation ratios result in different growth rates and ice crystal shapes, but also in different surface properties. Regarding on single ice crystal, the surface roughness can also be modified by varying the prevailing thermodynamic conditions. Thereby, the surface roughness tends to increase for growing and to decrease for shrinking particles. Here, we will present current results of the thermodynamic characterization measurements and the ongoing ice crystal growth experiments.